

## CLAIMS

We claim:

1. A method for provisioning at least one computing environment in a computing utility, said method comprising:

employing a description of each of said at least one computing environment, said description directing an invocation of a first service which performs said provisioning, said description being a composite resource definition; and

invoking said first service to perform said provisioning.

2. A method as recited in claim 1, wherein said first service is a provisioning resource service, and said method further comprises said first service making available a managed resource service for managing each of said at least one computing environment.

3. A method as recited in claim 2, wherein there is at least one provisioning resource service associated with each type of base resource and each type of composite resource.

4. A method as recited in claim 2, wherein said provisioning resource service provides a plurality of provisioning instances.

5. A method as recited in claim 2, wherein the step of invoking comprises:

obtaining at least one plan to satisfy said at least one computing environment;

selecting a particular plan;

requesting base resources corresponding to said particular plan from said computing utility;

repeating the steps of selecting and requesting until said base resources corresponding to said particular plan is obtained; and

configuring said base resources into an instance of said computing environment.

6. A method as recited in claim 5, wherein said base resources satisfy a request criterion taken from a group of request criteria comprising:

a designated time at which the resources will be provisioned;

duration of resource availability;

resource-specific selection criteria; and

any combination of these request criteria.

7. A method as recited in claim 2, wherein said provisioning resource service is comprised of a group of provisioning resource services, each member of said group of provisioning resource services is associated with a particular type of resource in said composite resource description.

8. A method as recited in claim 7, wherein the step of invoking further comprising employing said provisioning resource service for the computing environment by recursively employing each member of said group according to said composite resource description.

9. A method as recited in claim 2, wherein each base resource has a base resource instance, and wherein there is at least one managed resource service associated with each base resource instance.

10. A method as recited in claim 2, wherein each composite resource has a composite resource instance, and wherein there is at least one managed resource service associated with each composite resource instance.

11. A method as recited in claim 2, wherein said managed resource service is comprised of a group of managed resource services, each member of said group of managed resource services is associated with a particular instance of resource in said composite resource description.

12. A method as recited in claim 5, wherein said provisioning resource service is comprised of a group of provisioning resource services, each member of said group of provisioning resource services is associated with a particular type of resource in said composite resource description; and

wherein the step of invoking further comprising employing said provisioning resource service for the computing environment by recursively employing each member of said group according to said composite resource description; and

wherein the step of obtaining said at least one plan comprises recursively obtaining at least one plan for each sub-resource, and combining the result; and

wherein the step of configuring said base resources into an instance of said computing environment comprises recursively configuring base resources corresponding to each sub-resource, and configuring the result.

13. A method as recited in claim 5, wherein the step of obtaining further comprises specifying at least one condition restricting the plans obtained.

14. A method as recited in claim 5, wherein the step of selecting said plan satisfies a selection

criterion taken from a group of selection criteria comprising:

cost;

performance; and

number of preferences satisfied; and

any combination of these selection criteria.

15. A method as recited in claim 5, further comprising transforming reservations for base resources into allocated base resources.

16. A method as recited in claim 5, wherein the step of obtaining is repeated according to a repetition criterion taken from a group of repetition criteria comprising:

changes in the description of the computing environment;

changes in the set of base resource types;

changes in the set of composite resource types; and

any combination of these changes.

17. A method as recited in claim 5, wherein the step of selecting and requesting are repeated according to a repetition criterion taken from a group of repetition criteria comprising:

changes in the selection criteria;

changes in resource availability;

changes in resource reservation status;

changes in said at least one plan; and

any combination of these changes.

18. A method as recited in claim 15, further comprising iterating the steps of repeating and transforming until said base resources are obtained.

19. A method as recited in claim 5, wherein the steps of obtaining, selecting, requesting, and configuring are invoked at least once by at least one managed resource service to add resources to said computing environment.

20. An article of manufacture comprising a computer usable medium having computer readable program code means embodied therein for causing provisioning of at least one computing environment in a computing utility, the computer readable program code means in said article of manufacture comprising computer readable program code means for causing a computer to effect the steps of claim 1.

21. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for provisioning at least one computing environment in a computing utility, said method steps comprising the steps of claim 1.

22. A method comprising adding a base resource type to an operating computing utility, said step of adding comprising:

furnishing a base resource library service to represent any instance of said base resource type;

adding any instance of said base resource type to the base resource library service;

developing an implementation of a provisioning resource service for said base resource type;

activating said provisioning resource service; and

creating an implementation of a managed resource service for said base resource type.

23. A method as recited in claim 22, further comprising:

updating any provisioning resource service of any composite resource type to use said provisioning resource service for said base resource type; and

updating any managed resource service of any composite resource type to use said managed resource service for said base resource type.

24. A method as recited in claim 22, wherein the step of adding a base resource type is performed by a service provider to increase service offerings to at least one customer of said service provider.

25. A method comprising adding a composite resource type to an operating computing utility, said step of adding comprising:

creating an implementation of a provisioning resource service for said composite resource type, said provisioning resource service using the provisioning resource services for sub-resources of

said composite resource type;

activating said provisioning resource service; and

developing an implementation of a managed resource service for said composite resource type, said managed resource service using the managed resource services for sub-resources of said composite resource type.

26. A method as recited in claim 25, further comprising:

updating any provisioning resource service for a composite resource to use said provisioning resource service for said composite resource type; and

updating any managed resource service for a composite resource to use said managed resource service for said composite resource type.

27. A method as recited in claim 25, wherein the step of adding a composite resource type is performed by a service provider to increase service offerings to at least one customer of said service provider.

28. A method comprising adapting at least one third party workload management system for a computing environment to a computing utility, said step of adapting comprising:

developing a managed resource service, said managed resource service interpreting a state of said at least one third party workload management system; and

modifying a set of base resources comprising said computing environment as indicated by the state of said at least one third party workload management system.

29. A method as recited in claim 2, further comprising:

receiving an event for returning at least one base resource from said at least one base resource from at least one computing environment of said at least one computing environment;

unconfiguring said at least one base resource from at least one computing environment of said at least one computing environment;

returning said at least one base resource to said computing utility; and

making available said at least one base resource for allocation to another computing environment.

30. A method as recited in claim 9, wherein there is one managed resource service for all instances of a resource type within a single computing environment.

31. Method as recited in claim 1, wherein said description further comprises at least one condition on said composite resource definition.

32. A method as recited in claim 1, further comprising receiving a customer request for at least one of said at least one computing environment.

33. A method as recited in claim 1, wherein said composite resource definition is a recursive combination of resources, said combination being a combination taken from a group of combinations consisting of:

at least one base resource;

at least one other composite resource; and

any combination of base resources and composite resources.

34. A method as recited in claim 11, wherein said managed resource service employs at least one operation available to a particular member of said group of managed resource services, said operation being performed by at least one member of said group of managed resource services, said at least one operation being taken from a group of operations comprising:

delivering at least one metric based on monitored data from said computing environment;

delivering at least one event based on monitored data from said computing environment;

modifying a state of said computing environment;

modifying at least one resource of said computing environment;

invoking at least one particular operation to modify the computing environment in response to at least one particular metric; and

invoking at least one particular operation to modify the computing environment in response to at least one particular event.

35. An article of manufacture comprising a computer usable medium having computer readable program code means embodied therein for causing addition of a base resource type to an operating computing utility, the computer readable program code means in said article of manufacture comprising computer readable program code means for causing a computer to effect the steps of claim 1.

36. An apparatus to provision at least one computing environment in a computing utility, said apparatus comprising:

a first processor module to employ a description of each of said at least one computing

environment, said description directing an invocation of a first service which performs said provisioning, said description being a composite resource definition; and

a second processor module to invoke said first service to perform said provisioning.

37. An apparatus as recited in claim 36, wherein said second processor module makes available a managed resource service to manage each of said at least one computing environment.

38. A computer program product comprising a computer usable medium having computer readable program code means embodied therein for causing provisioning of at least one computing environment in a computing utility, the computer readable program code means in said computer program product comprising computer readable program code means for causing a computer to effect the functions of claim 36.

39. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for adding a base resource type to an operating computing utility, said method steps comprising the steps of claim 1.

40. An article of manufacture comprising a computer usable medium having computer readable program code means embodied therein for causing addition of a composite resource type to an operating computing utility, the computer readable program code means in said article of manufacture comprising computer readable program code means for causing a computer to effect the steps of claim 1.

41. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for adding a composite resource type to an operating computing utility, said method steps comprising the steps of claim 1.

42. An apparatus comprising:

a plurality of provisioning resource services to transform a description of a computing environment into a plan for constructing a set of resources to provide said computing environment, wherein the computing environment is represented as a composite resource definition.

43. An apparatus as recited in claim 42, wherein said plurality of provisioning resource services is to construct said resources into said computing environment according to said plan, and said at least one provisioning resource service to make available a managed resource service to manage the computing environment.

44. A method comprising:

obtaining a description of a computing environment, wherein said description is represented as a composite resource definition; and

transforming a description of a computing environment into a plan for constructing a set of resources to provide said computing environment.

45. An method as recited in claim 44, further comprising:

constructing said resources into said computing environment according to said plan; and

making available a managed resource service to manage the computing environment.

46. An article of manufacture comprising a computer usable medium having computer readable program code means embodied therein for obtaining a description of a computing environment, the computer readable program code means in said article of manufacture comprising computer readable program code means for causing a computer to effect the steps of claim 44.

47. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for obtaining a description of a computing environment, said method steps comprising the steps of claim 44.

48. An article of manufacture comprising a computer usable medium having computer readable program code means embodied therein for causing adaptation of at least one third party workload management system for a computing environment to a computing utility, the computer readable program code means in said article of manufacture comprising computer readable program code means for causing a computer to effect the steps of claim 28.

49. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform method steps for adapting at least one third party workload management system for a computing environment to a computing utility, said method steps comprising the steps of claim 28.

50. A computer program product comprising a computer usable medium having computer readable program code means embodied therein for causing development of a plan, the computer readable program code means in said computer program product comprising computer readable program code means for causing a computer to effect the functions of claim 42.

51. An method as recited in claim 1, further comprising a Provisioned and Managed Resource Service of a composite resource using the Provisioned and Managed Resource Service of a sub-resource to create and manage instances of the sub-resource.